International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2017 vol.17 N11, pages 133-140

Features of bitumen-containing sandstones of the volga-ural oil and gas province according to electron paramagnetic resonance and gamma spectrometry data

Mullakaev A., Khasanov R., Badrutdinov O., Khasanova N., Nizamutdnov N.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© SGEM2017. All Rights Reserved. On the territory of the Volga-Ural oil and gas province in the Permian sediments are concentrated significant resources of bitumen-containing rocks, which are of interest as a source of unconventional oil. In this connection, it is very important to clarify the conditions for the formation of bituminous strata and their productive areas. High efficiency in the study of oil-bearing rocks has radio-spectroscopic methods for determining the structure of the oil deposit and the nature of its oil and bitumen saturation, not only in carbonate rocks, but also in sandy-clayey varieties. In this paper are considered the results of analysis of reservoir rocks by electron-paramagnetic resonance (EPR) in combination with gamma spectrometry. The EPR method is used to study diamagnetic crystals where the paramagnetic centers are the impurity ions of Fe3+ and Mn2+ in calcite, dolomite, electron-hole centers in them, radiative E'-center in quartz, free radicals of organic matter of coal and oil series. These paramagnetic centers reflect the conditions and environment for the formation of minerals, the degree of degradation of the syngenetic material of rocks, reflecting different stages of post-sedimentation changes of rocks. Bitumen deposits belong to the Ufimian (Kungurian-ICS) stage (sheshminskiy horizon) of Permian period, which are represented by cross-bedded fine-t--medium-grained, polymictic sands and sandstones. According to the mineral composition, they belong to the Greywack group. In the clastic material of sandstones, there are grains of quartz, feldspar, mica, as well as particles of volcanic rocks, which was introduced from the Ural Mountains that were collapsing in the Permian time. Cement in sandstones is clayey-carbonate by composition, sometimes carbonate; by type - porous, pelitomorphic, basal. The mutual arrangement of grains of detrital minerals determines the poorly expressed banding of rocks. The intergranular space of the detrital component is largely filled with cement matter. The EPR method makes it possible to determine the paramagnetic centers reflecting the stages of diagenetic transformation of rocks and the degradation of organic matter. According to the EPR data, it was found that in the studied samples there are 2 types of organic matter, of oil and coal series. The oil substance has a migratory nature and, most likely, is associated with the oil rising from deeper horizons (Carboniferous deposits). The organic matter of the coal series has a syngenetic origin and is represented by the remains of vegetation (algae) and is deposited along with the primary sediments. One of the most important parameters is the radiation E'-center, which is observed in trigonal quartz. The E'-center creates if the trigonal quartz is irradiated by radioactive elements. The content of natural radionuclides of the 238 U (226 Ra) series, as well as 232 Th and 40 K was estimated in the samples under study by gamma spectrometry. The EPR spectra of the ion-radicals E' of quartz in the profiles of the studied wells

are highly correlated with 238 U (226 Ra) and 40 K. Herewith, their content prevails in the upper and lower parts of productive horizons. This suggests that the source of irradiation is in the rock itself. Such a source can be potassium feldspar, as well as insignificant concentrations of uranium. Uranium can be supplied as part of groundwater of the red-colored Ufimian deposits, which have the properties of alkaline solutions, and precipitate on contact with bitumen-bearing rocks.

http://dx.doi.org/10.5593/sgem2017/11/S01.017

Keywords

Bitumen, Composition, Deposit, Organic matter, Sandstones

References

[1] Khisamov R.S., Shargorodsky I.E., Gatiyatullin N.S. Petroleum bitumen of the Permian deposits of the South Tatar arch and the Melekess depression. - Kazan: "Feng" Publishing House of the Academy of Sciences of the Republic of Tatarstan, 2009. - 431 p. (in Russian)

[2] Brodny J., Stecuła K., Tutak M., Application of the TPM strategy to analyze the effectiveness of using a set of mining machines, Proceedings of 16th International Multidisciplinary Scientific GeoConferences SGEM 2016, Book 1, Vol. II, Albena Bulgaria, 2016, pp. 65-72. ISBN 978-619-7105-56-8, ISSN 1314-2704, DOI: 10.5593/sgem2016B12.

[3] Bulka G.R., Nizamutdinov N.M., Mukhutdinova N.G. et al. EPR Probes in Sedimentary Rocks: The Features of Mn2+ and Free Radicals Distribution in the Permian Formation in Tartarstan, Appl. Magn. Reson, 1991, V. 2, P. 107–115.

[4] Ikeya M. New Applications of Electron Spin Resonance- Dating, Dosimetry and Microscopy, World Scientific, Singapore, 1993, 509 p.

[5] Khasanov R.R., Galeev A.A. The Evolution of Syngenetic Organic Matter in Paleozoic Deposits in the Central Part of the Volga-Ural Anteclize. Uchenye Zapiski Kazanskogo Universiteta. Seriya Estestvennye Nauki, 2008, vol. 150, no. 3, pp. 152–161. (In Russian)

[6] Conard J. EPR in fossil carbonaceous materials, Magnetic Resonance. Introduction, Advanced Topics and Application to Fossil Energy/Eds. L. Petrakis, J.P. Fraissard, Dordrecht: Reidel, 1984, P. 441–459.

[7] Jezierski A., Czechowski F., Jerzykiewicz M., Drozd J. EPR Investigations of Structure of Humic Acids from Compost, Soil, Peat and Soft Brown Coal upon Oxidation and Metal Uptake, Appl. Magn. Reson, 2000, V. 1, No 18, P. 127–136.

[8] Shcherbina O.I., Brik A.B. Radiation-dose dependence of E1′ centers in samples of quartz containing uncharged oxygen vacancies. Physics of the Solid State, Volume 40, Number 4 (April 1998), pp. 597-599. Cul.maik.pss/1214574427.

[9] Khasanov R.R., Mullakaev A.I. Paleogeographic factors of the formation of Permian reservoir rocks of bitumen deposits in the east of the Russian plate (Russia)/16th International Multidisciplinary Scientific GeoConference SGEM 2016, SGEM2016 Conference Proceedings, 28 June - 7 July 2016, Book1 Vol. 1, 469-474 pp. DOI: 10.5593/SGEM2016/B11/S01.059

[10] Sakhibgareev R.S. Secondary Changes in Reservoirs during the Formation and Destruction of Oil Deposits. Leningrad, Nedra, 1989. 260 p. (In Russian)

[11] Y.N Zanin, A.G. Zamirailova, V.G. Eder. Uranium, thorium, and potassium in black shales of the Bazhenov Formation of the West Siberian marine basin Lithology and Mineral Resources. 2016. T. 51. № 1. C.74-85. DOI: 10.7868/S0024497X16010079